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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/657,776	09/08/2003	Eric S. Snow	NC 84,571	1831
26384	7590	09/22/2004	EXAMINER	
NAVAL RESEARCH LABORATORY ASSOCIATE COUNSEL (PATENTS) CODE 1008.2 4555 OVERLOOK AVENUE, S.W. WASHINGTON, DC 20375-5320			PERT, EVAN T	
			ART UNIT	PAPER NUMBER
			2829	

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/657,776	<b>Applicant(s)</b> SNOW ET AL.	
	<b>Examiner</b> Evan Pert	<b>Art Unit</b> 2829	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 08 September 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-21, 23-25 and 28-30 is/are rejected.
- 7) ☒ Claim(s) 22, 26 and 27 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 September 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some    \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Information Disclosure Statement***

1. The information disclosure statement filed 9-8-03 fails to comply with 37 CFR 1.98(a)(2)(ii), which requires applicant to submit a copy of "each publication or that portion which caused it to be listed."

While applicant may have already submitted the references cited in the IDS filed 9-8-03, the references were not scanned in the electronic filing system (e-Dan) at the time of examination and the references were not found in the electronic IDS database.

2. The IDS filed 9-8-03 will be considered when copies of the cited references are available.

### ***Drawings***

3. The drawings are generally acceptable, but contain some text that is blurred and some text that is less than 1/8 inch in height, contrary to 37 CFR 1.84(p)(3). New drawings are required, for compliance with Rule 84.

### ***Specification***

4. The first sentence of [0047] is incomplete. The phrase --was provided-- could be inserted before "in order," to correct this trivial informality.

### ***Claim Objections***

5. Claim 12 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim, or amend the claim to place the claim in proper dependent form, or rewrite the claim in independent form.

Claim 12 definitively recites that the "network" (of carbon nanotubes) "has electrical properties" that are "*related* to the composition and density of the network."

Yet, every network of nanotubes "has electrical properties" that are "related to the composition and density of the network." That is, the examiner is unable to locate any evidence of a situation where "electrical properties of a network of nanotubes" are "unrelated" to the "composition and density of the network."

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-4, 6, 10-13, 15-17, 24, 28 and 30 are rejected under 35 U.S.C. 102(e) as being anticipated by Watanabe et al. (US 2004/0041154 A1).

Regarding claim 1, Watanabe et al. disclose an electronic device [Fig. 13] comprising a substrate (116); an interconnected network of carbon nanotubes (110) on the surface of the substrate; and two electrical leads (114, 114'), wherein the network forms an electrical connection between the leads ([0025]+[0075]+[0203] w/ Figs. 14-16).

Regarding claim 2, Watanabe et al. disclose that the nanotube network may be made of single wall nanotubes [0092].

Regarding claim 3, Watanabe et al. disclose that the network (110) is a sub-mono-layer of carbon nanotubes [as *seen* in Fig. 15].

Regarding claim 4, Watanabe et al. disclose that the electrode height in Fig. 15 can range from 0.1 nm to 1 um [0086], which means that Watanabe et al. disclose an embodiment in Fig. 15 wherein the network is "about 100 nm thick."

Regarding claim 6, Watanabe et al. disclose that the single wall carbon nanotubes are only semiconducting, with metallic nanotubes ~~are~~ destroyed by current. Therefore, Watanabe et al. anticipate 100% semiconducting nanotubes and no metallic nanotubes, meeting the limitation drawn to an upper limit of density of metallic single-walled nanotubes [0013].

Regarding claim 10, Fig. 15 of Watanabe et al. shows at least 75% of the nanotubes in contact with the substrate.

Regarding claim 11, Watanabe et al. explains, "an active device cannot be manufactured unless the single-walled nanotubes have a semiconductor characteristic [0013].

Regarding claim 12, every network disclosed in Watanabe et al. "has electrical properties that are related to the composition and density of the network."

Regarding claim 13, Watanabe et al. disclose a filler material (112), such as resin, that fills in and encapsulates the network.

Regarding claim 15, "resin" is considered as being a "polymer."

Regarding claim 16, the distance between electrodes (114, 114') is seen as greater than the average length of the nanotubes of the network (110) [e.g. Fig. 16].

Regarding claim 17, the leads (electrodes 114, 114') are on the substrate 116 [e.g. Fig. 15].

Regarding claim 24, the device of Watanabe et al. can be exposed to a gaseous sample and the resistivity of the network changes in response to the presence of analytes in the sample [e.g. Fig 22].

Regarding claim 28, Watanabe et al. disclose that the leads (i.e. electrodes) may be silver [0023].

Regarding claim 30, Watanabe et al. disclose an electronic device comprising a substrate (116); an interconnected network of nanofilaments [i.e. carbon nanotubes] on the surface of the substrate [i.e. 110 in Fig. 15]; two electrical leads (114, 114'), the network electrically connected between the leads (e.g. "it is confirmed that current flows" per [0202] ).

8. Claims 1-3, 11-12, 17, 19-21 and 30 are rejected under 35 U.S.C. 102(e) as being anticipated by Gu et al. (US 2004/0104129 A1).

Regarding claim 1, Gu et al. discloses an electronic device [cover fig.] comprising a substrate (15); an interconnected network of carbon nanotubes (14) on the surface of the substrate; and two electrical leads (11, 12), wherein the network forms an electrical connection between the leads [0035].

Regarding claims 2 and 3, Gu et al. disclose that the nanotubes are carbon SWNTs [0030] in a sub-monolayer [wherein a sub-monolayer is considered as being a sub-layer that is a single layer, seen as 14 in the cover figure, for example].

Regarding claim 11, Gu et al. disclose that the tubes may be semiconducting [0030].

Regarding claim 12, every network disclosed in Gu et al. "has electrical properties that are related to the composition and density of the network."

Regarding claim 17, Gu et al. disclose that the leads 11 and 12 are on the substrate (the substrate being insulator layer 17 on base substrate 15).

Regarding claim 19, Gu et al. disclose an FET device, the network forming the channel between source and drain leads [cover figure].

Regarding claim 20, Gu et al. disclose that an insulating material 17 is located between the gate 15 and the network 14.

Regarding claim 21, Gu et al. disclose that the gate is part of the substrate (e.g. voltage source 13 biases the gate region via substrate 15)

Regarding claim 30, Gu et al. disclose an electronic device comprising a substrate (15); an interconnected network of nanofilaments [i.e. carbon nanotube network 14] on the surface of the substrate [i.e. 14 is on substrate 17/15 wherein a substrate coated with an insulating material is still a "substrate" and 14 is "on" this "substrate"]; two electrical leads (11, 12), the network electrically connected between the leads [0035].

9. Claims 1-3, 12-15, 17, 24 and 30 are rejected under 35 U.S.C. 102(e) as being anticipated by Dai et al. (US 6,528,020).

Regarding claim 1, Dai et al. disclose an electronic device [Fig. 3B] comprising a substrate (30); an interconnected network of carbon nanotubes (32) on the surface of the substrate; and two electrical leads (i.e. "electrodes 33" in Fig. 3B), wherein the network forms an electrical connection between the electrode leads [e.g. claim 1 in view of col. 2, lines 39-47].

Regarding claim 2, Dai et al. disclose that the nanotubes are SWNTs [col. 4, lines 50-51].

Regarding claim 3, Fig. 3B of Dai et al. shows the network as a sub-monolayer of carbon nanotubes.

Regarding claim 12, every network disclosed in Dai et al. "has electrical properties that are related to the composition and density of the network."

Regarding claim 13-15, Dai et al. disclose a polymer filler material wherein the filler material is altered by electrical properties of the network [col. 2, lines 54-58].

Regarding claim 17, Dai et al. disclose that the leads (i.e. electrodes 33) are on substrate 31/30.

Regarding claim 24, the network in Dai et al. can be exposed to a gaseous sample and the resistivity of the network changes in response to the presence of one or more analytes in the sample [col. 2, lines 59-62 w/ Fig. 4].

Regarding claim 30, Dai et al. disclose an electronic device comprising a substrate (30); an interconnected network of nanofilaments (32) on the surface of the substrate [Fig. 3B]; two electrical leads (i.e. electrodes 33), the network electrically connected between the leads (claim 1 in view of col. 2, lines 39-47).



***Claim Rejections - 35 USC § 103***

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 5 and 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al. as applied to claim 1 above:

Watanabe et al. is silent about the specifically claimed geometrical relationships that define upper and lower bounds of "density" of carbon nanotubes.

However, Watanabe et al. is not silent about "density" of the nanotubes [0101], [0146], [0147]:

Watanabe et al. explain that the "density" of "carbon nanotubes" should be "as high as possible," but not "too high in density" or else the "carbon nanotube group is caused to be a lump as a whole," leading to undesirable "gaps" (i.e. breaks or discontinuities).

Furthermore, Watanabe et al. set forth a range of sizes of nanotubes [0097]-[0099] and a range of distance between electrodes [0122] with a width of electrodes shown as half the distance between the electrodes [e.g. Fig. 13], which provides a range of parameters that establish a range of density relationships that overlap applicants claimed values of "carbon nanotube density."

The courts have held that a prior art range that overlaps a claimed range is not patentable, absent unexpected results. The specification is unclear as to what unexpected result is achieved by the claimed ranges and specific values of "density" of carbon nanotubes, some of which fall within density values inherent to the ranges of parameters disclosed by Watanabe et al..

12. Claims 18, 23, 25 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al. as applied to claim 1 above, and further in view of Tuominen et al. (US 2002/0158342 A1).

Claims 18, 23 and 25

Regarding claims 18, 23 and 25, Watanabe et al. does not recite a "flexible substrate," but does recite flexible substrate material at [0108] wherein the "substrate preferably has a high strength of some degree."

Tuominen et al. disclose that "flexible substrates" are advantageous, such as for "further expanding the utility" [0104] of "sensor technology" as part of a display [0104].

It would have been obvious to one of ordinary skill in the art at the time of the claimed invention to choose a material suggested by Watanabe et al. to form a "flexible substrate," motivated by the advantages a flexible substrate provides such as disclosed by Tuominen et al..

Claim 29

Regarding claim 29, Watanabe et al. are silent about including the disclosed sensor as part of a display, but Tuominen et al. disclose the advantages of integrating a display with nanotube technology, such as for "high-resolution, low power, thin and flexible display devices."

It would have been obvious at the time of the claimed invention to include the sensor device with network of nanotubes disclosed by Watanabe et al. in a "display device" disclosed by Tuominen et al., motivated to provide a device that is self-contained for displaying a sensor reading in the field [MPEP 2144].

***Allowable Subject Matter***

13. Claims 22, 26 and 27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

14. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 22, the prior art does not disclose applicant's claimed "electronic device" comprising a "network of carbon nanotubes" that "forms an electrical connection between source and drain leads of a transistor," wherein the "network of carbon nanotubes forms a conduction channel of the transistor," and wherein "*the transistor has an on-to-off ratio of at least about 100,000.*" While an on-to-off ratio for a transistor sensor is obviously ideally infinite (i.e. OFF is ideally OFF with zero current), applicant's written description is drawn to the enablement of an extremely high on-to-off ratio in the context of the disclosure of an enabled gas sensor comprising a network of nanotubes.

Regarding claims 26 and 27, the prior art does not disclose or suggest applicant's claimed "electronic device" comprising a "network of carbon nanotubes on the inside surface of a tube" [per claim 26 exemplified by Fig. 8], wherein the tube preferably "comprises quartz" [per claim 27].

### ***Conclusion***

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: US 2004/0067530 A1, US 2003/0198812 A1, US2003/0098640 A1, US2003/0068432 A1, US 2003/0058697 A1 and US 2002/0172639 A1 disclose carbon nanotube devices having some features of applicant's claimed invention.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Evan Pert whose telephone number is 571-272-1969. The examiner can normally be reached on M-F (7:30AM-3:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Tokar can be reached on 571-272-1812. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ETP  
September 17, 2004

  
**EVAN PERT**  
**PRIMARY EXAMINER**